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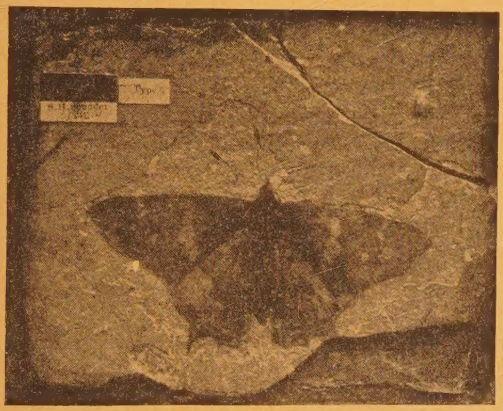

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PSYCHE

VOL. XXVI AUGUST, 1919 No. 4

NOTES ON FOREST INSECTS.

I. ON TWO BARK-BEETLES ATTACKING THE TRUNKS OF WHITE PINE TREES.

By M. W. Blackman, Ph.D.,
Professor of Forest Entomology, New York State College of Forestry, Syracuse, N. Y.

So little is known of the life history and habits of some of our common forest insects that even more or less casual or fragmentary observations are often of value and should be recorded in order to make them available for other workers. During the past few years the writer has accumulated a considerable amount of such data either in the way of more or less disconnected field observations, or in the course of work upon larger problems undertaken either individually or as joint problems with advanced student working in the laboratory. In the present paper are presented data upon several insects affecting the white pine, *Pinus strobus*. Part of the observations, especially the experimental data on *Hylurgops pinifex* Fitch and some of the field observations on *Ips longidens* Sw., were made by a former graduate student, Capt. A. J. MacNab, to whom we wish to make due acknowledgments.

Ips longidens Swaine.

Ips longidens was described by Swaine in 1911[1] (p. 214), but no later mention of it has been found in the literature except that by the same author (1918, p. 114).[2] The only host tree recorded is "Eastern Hemlock" and the distribution is given as New York State and Nova Scotia. Although not included by Blatchley and Leng (1916) among the Scolytidæ of northeastern North America, there can be no doubt as to the validity of the species. Indeed,

[1] Canadian Ent., Vol. XLIII, pp. 213–223.
[2] Dominion Canada, Dept. Agri., Ent. Br., Bull. 14, p. 114.

it is a rather common insect in central New York and is readily distinguished from its relatives not only by its structure but by its habits as well. Although Swaine (*loc. cit.*) mentions only hemlock (*Tsuga canadensis* Engelm) as the host tree, the writer has never been able to find it in this tree, but has observed hundreds of brood-burrows and thousands of specimens in all stages in the inner bark of white pine. This is especially unusual when we know that the type locality of this species is central New York (Ithaca) and our observations were made in the same general region of the state.

Ips longidens in central New York may work either as a primary or a secondary enemy of the white pine. It is found most commonly in the lower and middle regions of the trunks of trees in the pole stage—*i. e.*, from 4 to 8 inches in diameter. In larger trees, where it sometimes occurs, its brood-burrows are constructed in the middle and upper trunk regions and occasionally in the tops and branches. It is thus evident that the factor which determines the choice of location for breeding is the character of the bark. It prefers bark upon the older sapling or pole stage of white pine, the surface of which is roughened but which is still less than one fourth of an inch in thickness, although in a few instances the brood has been found successfully established in bark of a thickness as great as one half of an inch. On the other hand, the beetles have been induced to breed in captivity in limbs on which the bark is less than one eighth of an inch thick and the surface of which is smooth except near the origin of smaller limbs.

The brood of *Ips longidens* was found nearly exclusively in white pines of from 4 to 8 inches D. B. H. which were either dying or had been more or less weakened by overshading. The tops of these trees were small and ragged, the bark was thin, and the foliage scanty. Usually at the time when the beetles enter the trees the foliage has begun to turn yellow, but in some cases there are no indications that the tree is actually dying, but only of a weakened or suppressed condition. There can be no doubt that in many cases these bark beetles are the actual cause of the death of trees which would otherwise survive for may years. *Ips longidens* will also breed in felled pines in the pole stage and in the tops of larger trees.

The brood-burrows are always started in the new host tree by

the males[1] which leave their old host several days earlier than the females of the same age. Their methods of working have been observed by the writer under a binocular microscope, and correspond very closely with those employed by *Pityogenes hopkinsi* Swaine, which have been recorded in detail elsewhere (Blackman, 1915,[2] pp. 16–32). When the brood-burrow is made in the trunk, as it is in the great majority of cases, the entrance gallery, which is cylindrical and of a diameter just large enough to accommodate the insect making it, extends through the bark diagonally upward at an angle of about 45 degrees. On reaching the surface of the wood the male excavates an irregular shaped nuptical chamber which lies partly in the bark and partly in the sapwood.

The burrow is now ready for the females of which there are usually several for each male. Each of these immediately after her entrance begins to excavate a separate egg-gallery. In the majority of instances these galleries run in a direction perpendicular to the grain of the wood (Plate IV, fig. 2), although occasionally some females follow a course parallel to the grain. There are from one to five egg-galleries to each engraving. The following tables present, in summary, various data derived from a careful study of the engravings of *Ips longidens*.

Number of Egg-galleries, Based on a Study of 118 Engravings.

Brood-burrows having one egg-gallery	10
" " " two "	54
" " " three "	37
" " " four "	15
" " " five "	2
Average number of egg-galleries in a brood-burrow	2.53

Length of Egg-galleries, Based on the Study of 50 Engravings.

	Average length.	No. of galleries studied.
Uniramous burrow	25.37	8
Biramous "	19.42	54
Triramous "	17.5	24
Quadriramous "	16.9	28
Average length all types	18.8	114

[1] Cf. Blackman, 1915 Tech. Pub. No. 2, N. Y. State Coll. Forestry, pp. 15, 16. Blackman & Stage, 1918 Tech. Pub. No. 10, N. Y. State Coll. Forestry, p. 46.

[2] *Loc. cit.*

The relation between fecundity and the proportion of sexes in the various types of burrows is shown by the following tables of data:

Number of Egg-niches in the Egg-galleries, Based on a Study of 40 Engravings.

	Average no. of egg-niches.	No. of engravings studied.
Uniramous engraving	23	6
Biramous "	41.04	23
Triramous "	48.9	11
Average number to engraving	40.5	40
Egg-gallery of uniramous engraving	23	6
" " " biramous "	20.5	46
" " " triramous "	16.3	33
Average number, all types	19.05	85

From the above it is evident that each female under monogamic conditions produces more eggs than under conditions of bigamy or polygamy; but just as with *Polygraphus rufipennis* Kirby and *Eccoptogaster piceæ* Swaine (Blackman and Stage, *loc. cit.*, pp. 45, 53), the greatest individual reproductive efficiency exists when the burrow is occupied by one male and two females.

The larval burrows at the start are at nearly right angles to the egg-gallery (Plate IV, fig. 2) and are entirely in the inner bark. As they proceed farther, however, they groove the sapwood deeper and deeper and show a tendency to become winding in their course. These larval mines end in oval pupal chambers excavated nearly entirely from the sapwood. The new generation of adults continue feeding in the old host for weeks or sometimes even months before reaching sexual maturity. If young adults, fully mature so far as coloration and general appearance are concerned, are removed from their larval host tree and confined with new pieces of pine they will usually not breed until they have fed on the inner bark for a week or more.

On March 20, 1915, a number of young adults, removed from their hibernating quarters, were confined with several suitable pieces of white pine. Within two days all but a few, which had died, had entered the cut ends of the material, all of them making

simple cylindrical feeding burrows with no indication of a nuptial chamber. On April 1, all of the beetles were still in their feeding burrows, but by April 20, all but two or three had emerged and males and females were in newly established brood-burrows. On June 4, pupæ and callow adults of the new generation were obtained from these burrows. It is thus seen that, under laboratory conditions, callow adults of the new generation may be obtained from mature beetles in about 50 days, but these are not sexually mature until they have fed on the inner bark and sapwood for several weeks or a month. It is apparent that in central New York it is possible under field conditions for *Ips longidens* to complete two generations in an average year and in an especially long, warm season to increase this to two and one-half generations. Observations extending over a period of six years, however, convince the writer that ordinarily a single generation is the rule, although a partial second brood is by no means uncommon. There is thus a decided mixing of generations and new brood-burrows may be started at any time from May 15 (over-wintered adults) to September 15. Both adults and larvæ have been taken in the field on various dates including every month except December. The larvæ are as successful in withstanding winter conditions as are the young fully colored adults, and much more successful than are the callow beetles and pupæ.

The over-wintered adults leave their old hosts considerably later than do some other bark beetles. An instance of this was observed in the field by the writer in the spring of 1915. On April 24 of that year, the first individual of *Pityogenes hopkinsi* a male, was observed to have emerged and started its nuptial chamber in a new host near at hand. Within a week nearly all of the over-wintered males and many of the females had left this old host. On the other hand the over-wintered adults of *Ips longidens*, which occurred in the trunk of the same tree, did not leave their old host in any numbers until the middle and latter part of May.

Ips longidens has been found associated in the same tree with a considerable number of other bark and wood boring forms. Those most commonly associated include *Ips pini* Say, *Pityogenes hopkinsi* Swaine, *Crypturgus atomus* Lec., *Graphisurus fasciatus* DeG., and *Monohammus scutellatus* Say. These occur very commonly in the same regions in which *Ips longidens* prefers to breed. Other

forms, which have been found to be associated but not so commonly, include *Dendroctonus valens* Hopk., *Orthotomicus* (*Ips*) *cælatus* Eich., *Dryocœtes americanus* Hopk., *Hylurgops pinifex* Fitch, *Gnathotrichus materiarius* Fitch, *Cossonus corticola* Say, *Monohammus confusor* Kirby, *M. titillator* Fabr., *Rhagium lineatum* Oliv., and *Pytho americanus* Kirby, occurring principally in the lower trunk region of the pine tree; while *Pityophthorus granulatus* Swaine, *Chrysobothris femorata* Fabr., *C. dentipes* Germ., *Pogonocherus mixtus* Say, are occasionally associated in the tops and limbs.

Two beetles known to be predaceous were found rather commonly associated with *Ips longidens*. These are *Phyllobœnus dislocatus* Say and *Hypophlœus tenuis* Lec. One parasitic Hymenopteron, *Cœlopisthus* sp. was taken alive from a pupal chamber and there can be little doubt that it is parasite on this bark beetle.

Hylurgops pinifex Fitch.

Hylurgops pinifex differs markedly in habit from the preceding in that it is a monogamic form. It attacks white pines by preference although Hopkins[1] 1899, p. 449, records it from other species of pine as well, and Swaine[2] 1918, p. 81, lists the hosts as "Pines, Spruce and Eastern Larch." Its burrows are constructed in the lower part of standing pines and especially in the stumps of recently cut trees. The burrows have never been found by the writer at a greater height than seven feet from the ground and are more commonly in the lowermost three feet of the base of large thick-barked trees. This region is often heavily infested and the brood very frequently extend their burrows through the bark of the main roots to a distance of 6 or 8 inches under ground. The factor which determines the choice of the bases of trees is not entirely the character of the bark in the region attacked but is apparently the clumsy flight of the adult beetles, for in a number of cases felled trees have been found infested at a distance of 30 feet from their bases in regions where the bark was relatively thin, and in the laboratory the beetles have been induced to breed in similar material.

The brood-burrows of Hylurgops are radically different from those of *Ips longidens* or other polygamous forms, the most striking

[1] West Virginia Agr. Exp. Sta., Bull. 56.
[2] *Loc. cit.*

differences being correlated with the difference in breeding habits. Hylurgops appears to be strictly monogamic. Typically the brood-burrow consists of a simple, nearly straight longitudinal chamber extending either downward or upward from the entrance

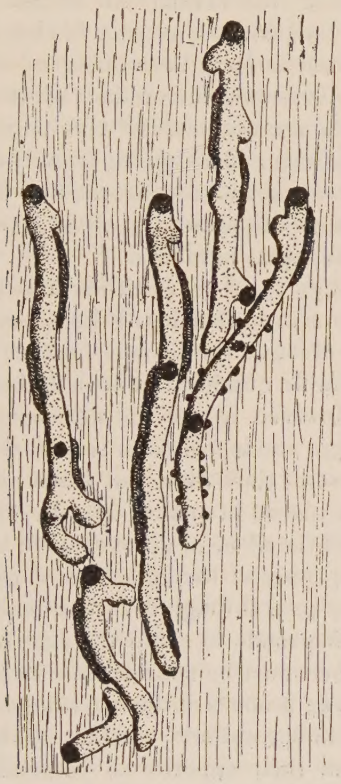


Figure 1. Burrows of *Hylurgops pinifex* in bark of white pine. Note the arrangement of the egg, either in niches or in grooves along the sides of the egg-gallery. Three-fourths natural size.

gallery (Fig. 1). Usually, just inside of the entrance there is a short branch or alcove, seldom greater in depth than the length of the beetle, which is used as a turning niche and also as a nuptial recess (Fig. 1; Plate 4, fig. 3). At or near the other end of the fully completed egg-gallery there is likely to be a somewhat similar recess which, however, instead of lying parallel to the surface of the wood extends outward part way through the bark. It doubt-

less is used by the female for reversing her position in the burrow. The remainder of the egg-gallery is a simple cylindrical mine which extends longitudinally, typically nearly straight, but frequently more or less curved. Its diameter is just great enough to allow convenient passage of the beetle. In length these egg-galleries vary from 50 to 85 mm. with an average of about 70 mm.

A number of instances have been observed where the same entrance gallery has been used in common by two or more pairs of beetles. That these are not cases of true polygamy is evidenced by the fact that each egg gallery arising from the common entrance has its own nuptial recess, and also by the fact that in all instances where the beetles were still present, the two sexes in these multiple burrows occurred in equal numbers.

The eggs are laid by the females either in niches or in longitudinal grooves along one or both sides of the egg-galleries, more typically in grooves. Most of the females appear to use the grooves entirely, a considerable number use both niches and grooves and none have been observed to use the niches exclusively. In the side grooves, the eggs are deposited in considerable numbers, often forming a layer several tiers wide, but when niches are used only from two to six are placed in one recess. In all cases the eggs are securely packed and the niche or groove closed with a layer of sawdust so that the opening of the gallery is of nearly uniform bore and the beetles may pass through it without endangering the eggs. No attempt has been made to count the eggs or larvæ of a single pair, but the number must be considerable as often the combined length of all of the egg-grooves of the two sides is equal to or greater than the length of the egg-gallery. In fact, the brood of Hylurgops is so numerous and their appetite so voracious, that it is very difficult to obtain brood-burrows fit for study unless the bark is stripped off before the larvæ have fed many days. Otherwise the feeding galleries of the larger larvæ and the young adults are carried back and forth over the egg-galleries until these become entirely unrecognizable.

The ability of the larvæ to live under adverse conditions is well illustrated by the following observations: On June 18, 1915, near Cranberry Lake, N. Y., several stumps of large white pine trees felled during the preceding winter were found to be heavily infested with *Hylurgops pinifex*, *Dendroctonus valens* Hopk., *Ips pini* Say,

and *Orthotomicus* (*Ips*) *cælatus* Eich. These stumps were still green and sappy and pitch exuded from all of the burrows, while those of D. *valens* had the characteristic pitch tubes. The burrows of Hylurgops were in all stages from those recently started to completed burrows containing recently hatched larvæ. In no case had these extended their burrows more than two centimeters, and in most instances eggs or larvæ just hatched occupied the egg-grooves in the sides of the galleries. The pieces of bark on being removed contained such good specimens of the early brood-burrows that a considerable number of them were taken to camp, wrapped in old newspapers, and shipped to the laboratory, no effort being made either to remove the brood or to preserve it from injury although specimens were taken. The boxes containing these bark specimens were not unpacked until September 2, when the writer was surprised to find large numbers of adults of the new generation burrowing into the bark or feeding upon its inner surface which was by then quite dry. These undoubtedly had developed from the young larvæ and eggs present on June 18. That the eggs then present had later hatched was readily established by an examination of the egg-grooves.

On October 20, 1916, numerous young adults found in their parent burrows, were brought into the laboratory and 46 of these placed in a celluloid box securely fastened to the rough bark of a section of the trunk of a recently cut, dying pine. Most of the beetles wandered about for the next few days in their enclosure, seeking a means of escape, some of them stridulating frequently. These latter were males. However, before the following morning several females had started burrows through the bark and within two days were observed to be casting out white chips, showing that they had begun to groove the sapwood. By October 25, all of the beetles except four had disappeared beneath the bark, many of them utilizing the entrance holes made by the first workers. One month later (November 25) a piece of bark near one of the entrance holes was carefully removed and eggs and young larvæ were found in considerable numbers. Some of the larvæ had burrowed for a distance of 35 mm. through the inner bark and were probably less than two weeks old. The eggs examined were oval in shape, slightly less than 1 mm. in their longest diameter, and contained well formed larvæ which hatched two days later.

The burrows made by the larvæ at first extend at right angles to the egg-gallery but soon become quite tortuous. They are rather extraordinary for their length frequently being from 25 to 30 cm. long and toward the last having a diameter of 4.5 to 5 mm. Before pupating, the full grown larvæ constructs a pupation chamber, which is often a more definite structure than is commonly made by scolytids. Ordinarily, pupation of those small beetles occurs in a simple cavity hollowed out of the bark or the wood. But in many cases *Hylurgops* builds a more elaborate structure somewhat similar to the hibernaculum of *Rhagium lineatum* and like this, consisting not only of an excavation in both bark and sapwood, but in addition surrounded by a wall made up of bits of wood, bark and excrement held together by a substance which acts as a glue (Plate IV, Fig. 4). The resemblance to the pupation chamber of *Rhagium* is still further heightened by the presence of a short passage-way made by the larva nearly through the outer bark. These pupal chambers are about 5 x 8 mm. in diameter. In several cases the larvæ had bored into the sapwood and made their pupal chambers entirely in the wood, sometimes penetrating the wood to a depth of nearly 5 mm. The entrance was plugged before pupation occurs and exit was had through a separate hole. Both of these sorts of pupation cavities should probably be considered as adaptations which serve to protect the tender pupæ from the larger larvæ and the young adults, which appear to have a very voracious appetite, and which extend their tunnels back and forth through the inner bark, often passing over and destroying egg-galleries and larval burrows alike.

Several full grown larvæ were taken from their pupation chamber and placed in Stender dishes in slightly moistened sawdust where they were kept under observation during all of the changes which ensued until they became fully colored adults. Briefly, the observations made are summarized below. The time required for the transforming of the larva to the pupa is about four and one-half hours. During most of this time the larva squirmed and wriggled and contorted its body nearly continuously with brief rests after each more violent effort. The effect here was, doubtless, the loosening up of the larval skin, and after about three hours of such efforts the skin appeared to be quite loose and something of the pupal form could be seen beneath it. Finally the larval skin split

lengthwise along the back of the thorax and head as far as the base of the mandibles, and through this opening the head and thorax of the pupa was pushed. It then required only a few minutes for the pupa to free itself of the old larval skin except where it was continuous with the lining of the alimentary canal at the anus. At this point the larval skin often adheres very firmly and sometimes is not dislodged for several days.

The newly transformed pupa is colorless except for a faint tinge of brown at the points of the dorsal spines of the abdomen. During the succeeding seven days various parts of the body acquired pigment in about the following order:—the mandibles, the eyes, bases of maxillæ and labrium, joints of femur and tibia, coxæ, tarsi, base of antennæ, scutellar region. At the end of a week the pupæ are ready to transform. The mandibles are motile, the body form is more like that of the adult and the elytra are no longer folded around the body with their tips ventral as at first, but now are dorso-lateral in position.

The first indication of the moulting of the pupa is a loosening of the pupal skin in the head region. Later the skin here splits and is soon slipped down over the pronotum whereupon the mandibles are used to tear it and release the prothoracic legs. The rest of the process is rapid as the legs are now brought into play and the body soon freed of the loosened covering. In one instance where transformation was observed, the entire process of moulting required eleven minutes.

The newly emerged adult is by no means as helpless as is the case with many Scolytids, and seems to require a considerably shorter time in attaining its adult color. Adults 36 hours old are brown-ochre in tint with wing covers opaque and in less than a week are dark brown, nearly black in color. There is normally but one generation of *Hylurgops pinifex* per year in central New York but if the young adults which ordinarily feed in their larval hosts from late summer until the following June are removed from their feeding burrows, they will readily enter a new host and start new brood-burrows.

As Hylurgops usually occurs only in the lowermost trunk regions, the forms commonly associated with it are of limited numbers. Perhaps the most common is *Orthotomicus* (*Ips*) *cœlatus* Eich., which in central New York is nearly invariably found in the

same stumps as Hylurgops. Other beetles frequently associated are *Dendroctonus valens* Hopk., *Dryocœtes americanus* Hopk., *Ips pini* Say, *Ips calligraphus* Germ., *Cossonus corticola* Say, *Monohammus confusor* Kirby, *M. titillator* Fabr., *Rhagium lineatum* Oliv., *Pytho americanus* Kirby, and occasionally *Gaphisurus fasciatus* DeG., and *Ips longidens* Swaine. Associates occurring in the feeding burrows of the young adults include *Glischrochilus sanguinolentus* Oliv., and several other unidentified nitulids and staphylinids.

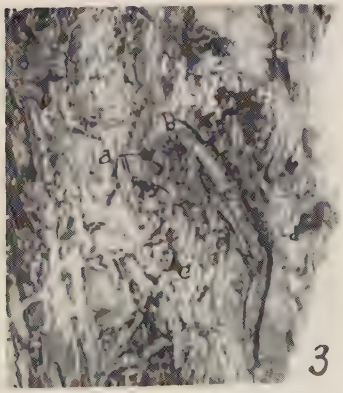
Explanation of Plate IV.

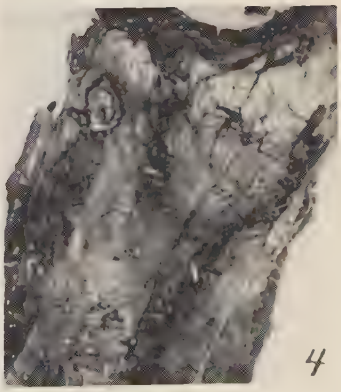
Fig. 1. View of the inner bark of white pine showing the brood-burrows of *Ips longidens*. In the egg-gallery shown below, the plugs of white frass by which the eggs are retained in their egg-niches are still plainly visible although the eggs have hatched long since. About three-fourths natural size.

Fig. 2. Engraving made by *Ips longidens* on the surface of the wood of white pine. The nuptial chamber (a), two transverse, (b) and one longitudinal (c) egg-galleries with their egg-niches, larval burrows (d) and the feeding burrows (e) of the young adults are shown. About two-thirds natural size.

Fig. 3. Brood-burrow of *Hylurgops pinifex* in the inner bark of white pine. Note the entrance gallery (a), the nuptial recess (b), the egg-gallery (c) with the egg-groove along the right side, the turning niche (d) and the burrows of the young larvæ (e). About one-half natural size.

Fig. 4. Fragment of the bark of white pine showing the pupal chamber of *Hylurgops pinifex*. About three-fifths natural size.





BLACKMAN—BARK-BEETLES.

THE ANT GENUS LORDOMYRMA EMERY.[1]

By William Morton Wheeler.

Lordomyrma is one of the few ant genera, like *Leptomyrmex* and *Opisthopsis*, which are confined to the Papuan and Australian regions. Although Emery established it as long ago as 1897 on *Podomyrma caledonica* Ern. André from New Caledonia and two species from German New Guinea, only a variety has since been added to the genus. It evidently comprises, however, two undescribed species in my collection, one taken by Mr. A. M. Lea of the Museum of South Australia on Lord Howe Island, off the coast of New South Wales and the other taken by myself in Queensland. Of the three species recognized by Emery only the worker is known. I have seen the male of the species from Lord Howe Island, but the females of all the forms still remain to be discovered. They are probably very similar to the female of *Podomyrma* and but slightly larger than the worker. I append descriptions of the genus and of the five known species, together with a table for their identification.

Lordomyrma Emery.

Emery, Természetr. Füzetek, 20, 1897, p. 591. ♀.

Worker. Small, monomorphic. Eyes small, elongate, rather flat, just in front of the middle of the head; ocelli absent. Mandibles triangular, with 3–4 apical and numerous small basal teeth. Clypeus well-developed, elevated in the middle behind, bicarinate, at least in most species, with entire anterior border, sinuate on the sides. Frontal area distinct, impressed; frontal groove absent. Frontal carinæ prolonged backward nearly to the posterior corners of the head as diverging ridge-like internal borders for flattened antennal scrobes, which are differently sculptured from the remainder of the head and bordered externally by a longitudinal ruga or carinula. Antennæ 12-jointed; funiculi with a distinct 3-jointed club as long as or longer than the remaining joints together. Thorax rather long and narrow, broadest through the pronotum, the humeri of which are dentate or sharply angular. There is no promesonotal suture, the dorsal surface of the two segments being rounded and convex. Mesoëpinotal suture very

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 158.

distinct, the mesonotum falling abruptly behind to the pronounced mesoëpinotal constriction, which is deep and narrow. Epinotum smaller and lower than the promesonotum, armed with acute teeth or spines both above and at the metasternal angles. Petiole and postpetiole much as in many *Leptothorax*, the petiole with a short peduncle and a high angular node, in one species produced into a spine, the postpetiole constricted behind, broader than the petiole. Gaster rather voluminous, broadly elliptical, somewhat compressed dorsoventrally, mostly formed by the first segment. Legs rather slender, the femora and tibiæ not conspicuously incrassated; middle and hind tibiæ without spurs.

Male. Smaller than the worker. Mandibles very small, vestigial, edentate. Cheeks short. Eyes moderately large; ocelli prominent, though small and rather far apart. Antennæ long, slender, filiform, 13-jointed; scapes long, nearly as long as the three basal joints of the funiculus, first funicular joint not swollen or enlarged. Thorax short; mesonotum with very feeble traces of Mayrian furrows; epinotum long, abrupt, somewhat concave, unarmed, without distinct base and declivity. Nodes of the petiole and postpetiole low. Genitalia small and retracted, the external valves simple, rounded at their tips. Wings hairy, with distinct pterostigma, a discoidal, a closed radial and a single large cubital cell.

Genotype: *Podomyrma caledonica* Ern. André.

This genus is very close to *Podomyrma*, but the species of the latter are larger ants, with 11-jointed antennæ in the workers and females, with more flattened, not bicarinate clypeus, with the epinotum unarmed or only feebly armed, the femora conspicuously incrassated and the petiole and postpetiole of a different shape.

Table of Species.

1. Apex of petiolar node produced into a spine above; epinotal spines very long, curved and diverging. Length 3.5 mm. *furcifera* Emery

   Apex of petiolar node angular, acuminate or acutely conical above; epinotal spines much shorter, nearly straight 2

2. Antennal scrobe anteriorly divided by a short median longitudinal carinula into separate depressions for the scape and funiculus. Length 3 mm. . . . . *cryptocera* Emery

   Antennal scrobe not thus divided 3

3. Upper surface of head, except the cheeks and spaces between the eyes and frontal carinæ, smooth and shining. Length 4.5–5 mm. ..... *caledonica* Ern. André

Upper surface of head between the frontal carinæ rugose. Length 3–3.6 mm. 4

4. Epinotal spines rather short, metasternal spines long; antennal scrobes incomplete behind; gaster not coarsely punctate *leœ* sp. nov.

Epinotal spines longer, metasternal spines short; antennal scrobes complete behind; gaster coarsely punctate *punctiventris* sp. nov.

1. Lordomyrma caledonica Ern. André.

Lodomyrma caledonica Ern. André, Rev. d'Ent. 8, 1889, p. 225. ☿.

"*Worker.* Ferruginous, shining; mandibular teeth, anterior border of head, femora, tibiæ and the two posterior thirds of the gaster, sometimes also the upper surface of the head with the scapes, more or less brown. Mandibles nearly smooth and shining, with a few, very scattered punctures; their terminal border armed with three teeth anteriorly and indistinctly denticulate behind. Head (without the mandibles) nearly as long as broad, slightly narrowed in front, strongly rounded at the posterior angles. Cheeks in front of the eyes, together with the spaces between the eyes and the frontal carinæ, longitudinally rugose, the rugæ becoming semicircular around the articulations of the antennæ; the remainder of the head, with the clypeus and frontal area, smooth and very shining. Antennæ 12-jointed; funicular joints 2–7 transverse. Thorax with coarse rugæ, transverse above, longitudinal on the sides; the sculpture rather effaced on the disc of the pronotum and the declivity of the epinotum. Pronotum convex, unarmed above, its inferior border much raised above the articulation of the anterior coxæ and terminating in front in a blunt denticle. There is a deep constriction between the mesonotum and epinotum; the latter, very narrow above, terminates at the juncture of the basal and declivous surfaces in two strong, acute teeth, which are very divergent and directed upward. Petiole surmounted by an acute cone, inclined forward; postpetiole transverse, armed with a small dentiform tubercle at its anterior angles; the petiole is transversely rugose above, the postpetiole nearly smooth, except behind, where there are a few more or less effaced

rugæ. Gaster smooth and very shining. Coxæ very globular; femora only slightly swollen; four posterior tibiæ without spurs. Whole body, including the antennal scapes and legs bristling with long, yellowish, delicate and moderately abundant hairs. Length 4.5–5 mm.

"Nouméa (New Caledonia)."

2. Lordomyrma furcifera Emery.

(Fig. 1.)

Természetr. Füzetek 20, 1897, p. 591, Pl. 15, Figs. 32, 33. ☿.

"*Worker.* Fuscopiceous; mouth, antennæ, posterior half of thorax, femora, tarsi, petiole and ventral surface of gaster reddish ferruginous, very shining; smooth, sparsely covered with minute

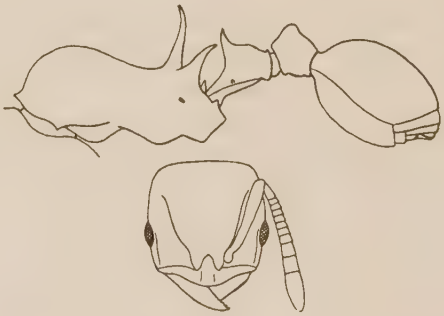


Figure 1. *Lordomyrma furcifera* Emery (after Emery) worker; *a*, thorax and abdomen in profile; *b*, head, dorsal view.

punctures bearing rather stout, fuscous hairs. Head oblong, with subparallel sides, broadly rounded behind. Eyes in front of the middle of the sides of the head. Cheeks striated. Frontal carinæ delicately prolonged backward, $\frac{3}{4}$ the length of the head, forming the inner borders of broad, shallow antennal scrobes which are open behind but bounded externally by a delicate carina. Clypeus bicarinate in the middle, its anterior border arcuately produced. Mandibles smooth, elongate triangular, with oblique apical margin, bidentate at the tip, irregularly denticulate basally. Antennal scapes reaching beyond the frontal carinæ but not to the posterior corners of the head; scape stout; club elongate, moderately thick, penultimate joint about half again as long as the antepenultimate, the last joint as long as the two preceding together

but scarcely thicker than the penultimate. Thorax with the promesonotum very convex, subglobose, acutely marginate in front, the margin ending on each side in a tooth; metaëpinotum subselliform, with two very long spines, approximated at their bases, strongly diverging, curved outward and very acute; metasternal spinules minute, acute. Petiole a little broader behind than in front, with a high subconical node, bearing a short acute, erect spine, behind transversely rugose; postpetiole subrotund, obtusely acuminate above, bearing a minute tubercle on each side. Gaster subrotund, almost entirely covered by the basal segment. Legs long, femora flexuous. Length 3.5 mm.

"From the Lemien Forest near Berlinhafen [German New Guinea]; a single specimen [L. Biró]."

3. **Lordomyrma cryptocera** Emery.

(Fig. 2.)

Természetr. Füzetek 20, 1897, p. 592, Pl. 15, Fig. 34. ☿.

"*Worker.* Piceous; mandibles, antennæ, tarsi and articulations of the legs ferruginous; very shining, covered with minute, scat-

Figure 2. *Lordomyrma cryptocera* Emery, worker (after Emery), body in profile.

tered, piligerous punctures. Head longer than broad; its sides broadly arcuate, truncate behind, with rounded posterior corners, marginate on each side beneath. Eyes at the middle of the sides of the head. Frontal carinæ prolonged backward, forming the inner boundaries of a scrobe or fovea on each side and becoming arcuately confluent with a carinula that forms its lateral boundary. Cheeks, sides of head lateral to the scrobes and the lateral margin of the front anteriorly longitudinally striate. Clypeus anteriorly elevated and bicarinate, with rounded anterior margin. Mandibles smooth, with very oblique, denticulate apical margin. Antennal scape short, funiculus longer, slender at the base, but with joints 2–7 much thicker than long; club much elongated and only

slightly incrassate; the last joint subcylindrical. Whole antenna accommodated in the scrobe which at the base has a longitudinal carinula separating it into two grooves, one for the scape and one for the funiculus. The funicular groove is prolonged anteriorly (for the apex of the club) between the clypeus and the base of the mandible. Thorax with the promesonotum subhemispherical, narrowly marginate on each side anteriorly, above and on the side with several separated rugæ, between the mesonotum and epinotum with a deep transverse groove, which is longitudinally striate, behind the groove with a transverse carina. Epinotum with sharp, arcuate rugæ between the moderately long, oblique, curved spines; pleuræ obliquely rugose. Petiole pedunculate at base, behind with a subrotund node, anteriorly acuminate but unarmed above, irregularly, transversely rugose. Postpetiole broader than petiolar node, ovate, a little broader than long, somewhat smooth. Gaster ovate, almost entirely covered by the basal segment. Legs shorter than in the preceding species; femora flexuous, incrassated in the middle. Length 3 mm.

"Collected with the preceding in the Lemien Forest near Berlinhafen [German New Guinea]; a single specimen [L. Biró]."

3a. **Lordomyrma cryptocera** var. **acuminata** Stitz.

L. cryptocera var. *accuminata* [*sic!*] Stitz, Sitzb. Gesell. naturf. Freunde Berlin. 1912, p. 504. ♀.

Agreeing with the description of the type except as follows: "The head is smooth, except for a few longitudinal striæ below the eyes and a fine longitudinal striation between the anterior borders of the frontal carinæ and the adjacent portion of the clypeus. The epinotum behind the shallow mesoëpinotal impression, which is longitudinally striate, is transversely rugose on the base and declivity. The epinotal spines are more slender. The petiolar node seen in profile has the form of an equilateral triangle and bears above a small, pointed but distinct tooth, which is lacking in the type though indicated in Emery's figure.

"Four workers. New Guinea (K. A. Fl. E. Bürgers)."

4. **Lordomyrma leæ** sp. nov.

(Fig. 3.)

Worker. Length 3.4–3.6 mm.

Head longer than broad, as broad in front as behind, with feebly rounded sides, nearly straight posterior border and broadly rounded

posterior corners. Eyes in front of the middle of the head, small, elongate, rather flat and oblique. Mandibles rather convex, thin, with straight external borders; apical borders with three larger anterior and numerous minute basal teeth. Scrobes shallow, incomplete behind, about $\frac{4}{5}$ as long as the head. Antennal scapes extending to the posterior corners of the head; joints 2–7 of the funiculus narrow but broader than long; ninth and tenth joints distinctly longer than broad, together as long as the terminal joint. Clypeus high and convex in the middle, bluntly bicarinate, its anterior border broadly rounded and entire, feebly sinuate on the

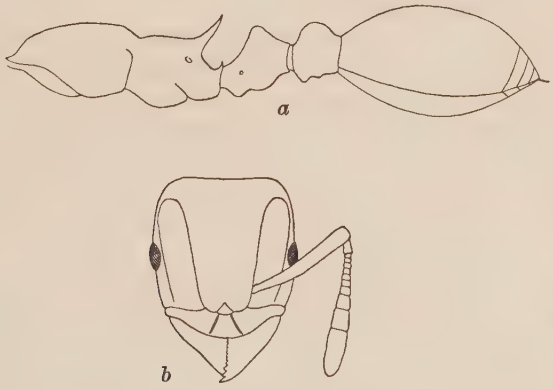


Figure 3. *Lordomyrma leæ* sp. nov. worker; *a*, thorax and abdomen in profile; *b*, head, dorsal view.

sides. Promesonotum gradually narrowed behind, rather straight above in profile, decidedly longer than broad, the humeri subdentate, the mesonotum behind falling abruptly to the pronounced mesoëpinotal constriction. Epinotum slightly longer than broad, a little broader behind than in front, its spines short, broad at the base, very acute; metasternal spines slender, acute and like the superior spines directed upward. Base of epinotum in profile feebly convex, longer than the sloping, flattened declivity. Petiole longer than broad, broader behind than in front, its peduncle short, the node in profile angular, its anterior slope slightly concave, its posterior slope slightly convex. Postpetiole broader than long and broader than the petiole, rounded above and on the sides,

constricted behind, with a blunt, transverse anteroventral projection. Gaster rather larger, somewhat longer than the thorax. Legs not incrassated.

Shining, especially the mandibles, clypeus and gaster. Mandibles sparsely punctate, clypeus smooth, indistinctly rugulose on the sides. Head longitudinally rugose, the rugæ becoming coarsely reticulate on the occipital region. Scrobes and interrugal spaces indistinctly punctate-reticulate. Region of the frontal groove occupied by a smooth shining longitudinal streak. Thorax, petiole and postpetiole irregularly, their upper surfaces more transversely rugose. Declivity of epinotum smooth and shining. Gaster with sparse, piligerous punctures.

Hairs moderately long and abundant, erect or suberect, yellowish, bristly, covering all parts of the body, shorter and sparser on the legs and scapes, rather dense on the funiculi.

Dark piceous brown; thorax, petiole and postpetiole nearly black; mandibles, clypeus, cheeks, base and tip of gaster, legs, including the coxæ, first joint of funiculi and their clubs reddish brown.

Male. Length 3 mm.

Head as broad as long, broadly rounded behind, without posterior angles, somewhat flattened above, with very short cheeks. Clypeus much as in the worker. Pronotum visible from above, not overarched by the mesonotum which is as broad as long. Scutellum not very prominent. Epinotum sloping, simple, unarmed. Petiole fully twice as long as high and more than twice as long as broad, parallel-sided. Postpetiole from above broader, nearly square.

Head and thorax subopaque, rather finely and irregularly punctate-rugulose; mesopleuræ, a longitudinal streak on the front of the head, the petiole, postpetiole and gaster smooth and shining, the gaster with fine sparse piligerous punctures.

Hairs finer and more oblique than in the worker, very numerous on the antennæ and wings, which are unusually pubescent.

Dark piceous brown, nearly black; legs and antennæ paler; clypeus and mandibles yellowish. Wings opaque brownish, with brown veins and pterostigma.

Described from numerous workers and five males collected by Mr. A. M. Lea on Lord Howe Island.

5. **Lordomyrma punctiventris** sp. nov.

(Fig. 4.)

Worker. Length 3–3.2 mm.

Head subrectangular, a little longer than broad, with nearly straight posterior border and subparallel sides. Eyes small, elongate, placed obliquely a little in front of the middle of the sides. Mandibles like those of *leæ* but thicker, more deflected at the tips and with slightly concave external borders. Clypeus convex in the middle, with two strong carinæ, which do not reach the anterior border. The surface between them is concave. Antennal

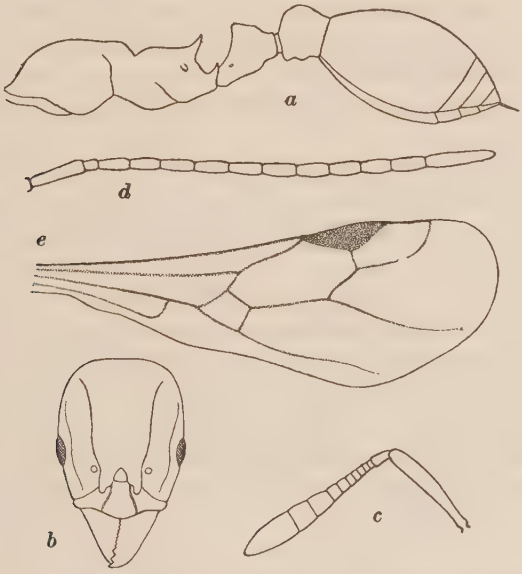


Figure 4. *Lordomyrma punctiventris* sp. nov.; *a*, thorax and abdomen of worker; *b*, head and *c*, antenna of same; *d*, antenna and *e*, wing of male.

scrobes more sharply defined and deeper than in *leæ*, complete behind, about $\frac{4}{5}$ as long as the head, the prolonged frontal carinæ more prominent. Antennal scapes stout, as long as head; funicular joints 2–7 very short and transverse, 9 and 10 together shorter than the terminal joint. Thorax more robust than in *leæ*, with dentate humeral angles, the pro- and mesonotum above rounded and slightly depressed, the latter falling less abruptly

behind than in *leæ* to the pronounced mesoëpinotal constriction. Epinotum as broad as long, its spines less erect, longer, nearly as long as the rather convex base; metasternal spines very short, erect, acute. Petiole from above about $1\frac{1}{2}$ times as long as broad, broader behind than in front; in profile as high as long, with angularly pointed node, its anterior slope concave, its posterior slope straight. Postpetiole broader than long, broader than the petiole and somewhat broader in front than behind, dentate anteriorly on the ventral side. Gaster and legs as in *leæ*.

Mandibles shining, finely and very sparsely punctate; head, thorax, petiole and postpetiole subopaque evenly reticulate-rugose, the head in front and on the sides longitudinally rugose, the scrobes shining and finely, transversely rugulose. Gaster shining, covered with rather strong, transverse piligerous punctures. Antennal scapes very finely rugulose; legs smooth, sparsely and finely punctate.

Hairs yellowish gray, appearing blackish in some lights, moderately abundant, especially on the gaster, erect or suberect on the body, shorter and more oblique on the legs, reduced to pubescence on the antennæ.

Head, thorax, petiole and postpetiole rich castaneous; mandibles, antennæ and gaster pale orange brown; legs more yellow.

Described from twenty-one specimens, comprising nearly an entire colony, taken from a small cavity in a rotten log in the dark tropical "scrub" at Kuranda, Queensland. In life these ants are sluggish and timid, like the species of *Podomyrma*. The latter, however, nest in the trunks and branches of living trees and move about in the sunlight.

A NEW PAPER-MAKING CREMATOGASTER FROM THE SOUTHEASTERN UNITED STATES.[1]

By William Morton Wheeler.

More than thirty years ago the late Prof. George F. Atkinson described and figured a large, elongate elliptical paper nest which he took to be the work of our common acrobat ant, *Crematogaster lineolata* Say.[2] The structure, "about eighteen inches long by twelve inches in circumference at greatest diameter" was discovered by H. A. Brown in the marshes bordering Broad Creek, Hyde County, N. C., and was "built several feet from the ground on a bush." The material was "of a light gray color, much like that of the nest of the white-faced hornet," but was darker internally, almost black in some places. Atkinson believed that the *Crematogaster*, instead of building in its usual manner under stones or logs, where it not infrequently covers the walls of its chambers with a variable amount of dark-colored carton, had adopted the arboreal habit as a "singular adaptation" to living in a swamp. As I saw no reason to question the correctness of his identification of the ant, I have on two or three occasions expressed the same opinion.[3]

About a year ago Dr. E. F. Bigelow sent me a photograph and fragments of a large paper nest found by Mr. J. Willis Youngs at Fort Myers, Fla., together with some of the ants that had constructed it. Dr. Bigelow subsequently published the photograph with a few notes.[4] The nest as shown in the photograph is much damaged but must have been originally more than a foot in length. A study of the ants shows that they represent an undescribed species, closely related to *C. lineolata* but easily recognizable as distinct. I feel reasonably certain from an examination of the carton and a comparison of Atkinson's and Bigelow's figures that both nests were built by the same species of ant.

Very recently Dr. W. M. Mann sent me specimens of the same

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 157.

[2] Singular Adaptation in Nest-making by an Ant, *Cremastogaster lineolata* Say. Amer. Natural. 21, 1887, pp. 770–771, Pl. 26.

[3] The Habits of the Tent-building Ant (*Crematogaster lineolata* Say). Bull. American Mus. Nat. Hist. 22, 1906, p. 15; Vestigial Instincts in Insects and other Animals. Amer. Journ. Psychol. 19, 1908, p. 4.

[4] A Very Interesting Study of Ants. Guide to Nature 11, March 1919, p. 270.

Crematogaster from a paper nest found by E. S. Snyder on a willow tree, two feet above the ground, on Paradise Key, Fla., and on critically examining the large series of *Crematogaster* that have been accumulating in my collection for more than twenty years, I find specimens of the same ant and of a yellow variety from several localities in Florida, Georgia and North Carolina. Prof. J. H. Comstock gave me Atkinson's original photograph of the nest described from North Carolina. I reproduce it in the hope that the more modern half-tone process may bring out the texture of the carton even more clearly than in the original article. I also reproduce a photograph of the Paradise Key nest kindly loaned me by Dr. Mann.

The new *Crematogaster* and its variety are herewith described.

Crematogaster atkinsoni sp. nov.

(Fig. 1 *b*.)

Worker. Length 2.5–3.3 mm.

Similar to the typical *lineolata* Say, but smaller, the latter measuring from 3 to 4 mm., with the thorax, especially the pro- and mesonotum more slender, the promesonotal suture more indistinct, the mesonotum more flattened and with more indistinct longitudinal carina. Head smaller and proportionally narrower; the frontal groove much less distinct. Antennal scapes longer, reaching about twice their greatest diameter beyond the posterior border of the head. Epinotal spines decidedly longer, straight, more slender and more acute, longer than the base of the epinotum and as long as the distance between their insertions. They are widely divergent and directed less backward and somewhat more obliquely upward than in the typical *lineolata*.

Surface smooth and shining, the thorax above without traces of the distinct puncturation and rugulation of *lineolata*, except the base of the epinotum, which is longitudinally rugulose. Mesopleuræ opaque, finely and densely punctate. Epinotal declivity very smooth and shining as are also the upper surfaces of the petiole and postpetiole (opaque or subopaque in *lineolata*). Head and gaster highly polished, except the mandibles and cheeks which are subopaque and finely striate, and the clypeus, which is indistinctly striate and somewhat less shining than the front and vertex.

Pubescence much as in the typical *lineolata*, but the erect hairs are sparser, the appressed hairs on the legs shorter. The hairs on the antennal scapes, however, are longer, more abundant and oblique.

Color like that of the typical *lineolata*, castaneous with black gaster, the latter sometimes paler at the base; antennæ and legs more reddish brown, with the middle portions of the femora and tibiæ and the tip of the last antennal joint piceous or blackish.

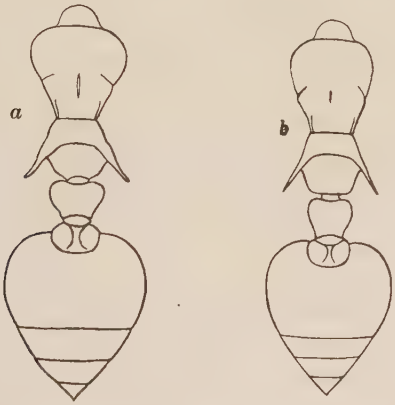


Figure 1. *a*, Thorax and abdomen of worker *Crematogaster lineolata* Say; *b*, *b*, *C. atkinsoni* sp. nov.

Some specimens have the head and thorax more blackish, with the mandibles, cheeks, clypeus, tarsi, articulations of the legs, thorax, petiole, and postpetiole reddish brown or deep red.

Described from several workers from Fort Myers, Fla. (J. W. Youngs) which may be regarded as the type-locality. I possess other specimens taken in the following localities in the same state: Titusville (Amer. Mus. Nat. Hist.); Crescent City (Van Duzee); Jacksonville (Mrs. A. T. Slosson); Paradise Key; (E. S. Snyder) and Tallahassee.

C. atkinsoni var. helveola var. nov.

Worker. Like the typical form of the species, except in color. Brownish yellow, legs slightly paler; posterior half of gaster and sometimes also the upper surface of the head pale brown.

Female (deälated). Length 6.5 mm.

Much smaller than the female of the typical *lineolata*, which measures 8–8.5 mm. Head more rectangular and fully as long as broad (broader in *lineolata*, with more rounded sides and posterior corners). Epinotal spines reduced to stout teeth as in *lineolata* but shorter and slightly more deflected. Metanotum (postscutellum) much less protuberant in profile.

Surface of body smoother and more shining, covered with fine, sparse, piligerous punctures; mandibles and anterior half of head longitudinally striate, mandibles rather opaque.

Hairs whitish, apparently less abundant than in *lineolata*, pubescence much the same. Hairs on the scapes shorter and less conspicuous than in the worker.

Colored like the worker, but the scutellum, an anteromedian and an elongate spot on each side of the mesonotum and the whole gaster brown; each segment of the latter with a narrow, transverse, dark brown band near the posterior margin. Mandibles red, with black apical margins.

Male. Length about 3 mm.

Smaller than the male of the typical *lineolata*, which measures 4–4.5 mm. Head blackish; thorax, petiole and postpetiole chocolate brown; antennæ and legs, mandibles and gaster brownish yellow, the dorsal surface of the gaster darker. Wings white, with colorless veins and stigma. Head and gaster somewhat shining, thorax more opaque. Pilosity much less developed than in the male of *lineolata*.

Described from several workers and males and a single female taken by Prof. J. C. Bradley in the Okefenokee Swamp, Ga. (type locality). The Rev. P. J. Schmitt sent me many years ago several workers which he had taken at Lake Worth, Fla., and Belmont, N. C.

C. atkinsoni is very closely allied to *C. ashmeadi* Mayr and to *lineolata* subsp. *læviuscula* Mayr. Both of these forms have the surface of the body smooth and shining, though in *læviuscula* and its vars. *clara* Mayr and *californica* Emery the thorax is distinctly sculptured. *C. ashmeadi* is, however, smaller than *atkinsoni* in both worker and female phases, and the worker has the epinotal spines reduced to stout distinctly incurved teeth. The epinotal spines of the typical *læviuscula* are shorter and more sinuate than in *atkinsoni* and the vars. *clara* and *californica* are larger, of a very

different color and with much more opaque and sculptured thorax and pedicel.

After renewed study of the North American Crematogasters in my collection, and of most of the forms in the field, I incline to regard those that have been cited as subspecies of *lineolata* by Emery and myself, namely *pilosa* Pergande, *læviuscula* Mayr, *coarctata* Mayr and *opaca* Mayr, as worthy of specific rank. This is merely a return to the position of Mayr, who described the three latter forms as separate species. The complete list of Crematogasters known to inhabit America north of Mexico, and including the two described above, would run as follows:

C. lineolata Say.
  var. *cerasi* Fitch
  var. *lutescens* Emery
  var. *subopaca* Emery
pilosa Pergande
læviuscula Mayr
  var. *clara* Mayr
  var. *californica* Emery
coarctata Mayr
  var. *mormonum* Emery
opaca Mayr var. *depilis* Wheeler
  var. *punctulata* Emery
atkinsoni Wheeler
  var. *helveola* Wheeler
ashmeadi Mayr
vermiculata Emery
arizonensis Wheeler
victima Smith subsp. *missouriensis* Pergande
minutissima Mayr

Additional data on the habits of *C. atkinsoni* would be of considerable interest. Consultation of the atlas shows that, with the exception of Belmont, N. C., all the localities cited for this ant and its variety are near the sea-shore, where the species seems to be confined to swamps, or, at any rate, to regions subject to periodic inundation. This may account for the fact that its nest has been so seldom seen, although the ant may be a rather rare relict of a time when the Southeastern States had a more tropical climate.

Wheeler – Paper-making Crematogaster

THE ANTS OF TOBAGO ISLAND.

By William Morton Wheeler,
Bussey Institution, Harvard University.

During April, 1918, Prof. A. L. Treadwell of Vassar College collected such ants as he could find on the island of Tobago and sent them to me for identification. The island is situated only twenty miles northeast of Trinidad and is twenty-six miles long and seven and one-half miles broad. Though it might be expected to have a rich ant-fauna somewhat resembling that of Trinidad, Professor Treadwell succeeded in taking only the following eight species:

1. *Odontomachus hæmatoda* L. Numerous workers of the typical dark form from Spey-Side.
2. *Solenopsis geminata* Fabr. Numerous workers from Milford and Pigeon Point.
3. *Pheidole megacephala* Fabr. A few soldiers and many workers from Pigeon Point and some other localities on the island, "nesting in the sand of the seashore."
4. *Pheidole fallax* Mayr subsp. *emiliæ* Forel. A single soldier from Pigeon Point.
5. *Acromyrmex octospinosa* Reich. Two workers from Pigeon Point.
6. *Prenolepis* (*Nylanderia*) *longicornis* Latr. Several workers from Spey-Side.
7. *Camponotus* (*Myrmothrix*) *abdominalis* Fabr. Seven workers of the typical form of this variable species from Pigeon Point and St. Patrick's Cathedral, "nesting in a calabash."
8. *Camponotus* (*Myrmamblys*) *fastigiatus* Mayr. Eleven workers from Milford.

Four of these ants, namely *Odontomachus hæmatoda, Solenopsis geminata, Pheidole megacephala* and *Prenolepis longicornis,* are everywhere abundant "tramps" in the tropics of both hemispheres. The other four are common species of Trinidad and the adjacent South American continent. The introduction of *Pheidole megacephala* into so small an island as Tobago must have led to the extermination of any primitive or indigenous ant-fauna it may have possessed. The few forms taken by Professor Treadwell probably represent all or nearly all the species that are sufficiently resistant or aggressive to withstand the inroads of such a pest as *megacephala.*

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